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HIGHWAYS DEPARTMENT
港珠澳大橋香港工程管理處
Hong Kong - Zhuhai - Macao Bridge
Hong Kong Project Management Office

Contract No. HY/2011/03

Hong Kong-Zhuhai-Macao Bridge Hong Kong Link Road Section between Scenic Hill and Hong Kong Boundary Crossing Facilities

Quarterly EM&A Report No.7 (Mar 2014 to May 2014)

24 July 2014

Revision 1

Main Contractor

中國建築工程(香港)有限公司
CHINA STATE CONSTRUCTION ENGINEERING (HONG KONG) LTD.

Designer

ATKINS

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Executive Summary

The Hong Kong-Zhuhai-Macao Bridge (HZMB) Hong Kong Link Road (HKLR) serves to connect the HZMB Main Bridge at the Hong Kong Special Administrative Region (HKSAR) Boundary and the HZMB Hong Kong Boundary Crossing Facilities (HKBCF) located at the north eastern waters of the Hong Kong International Airport (HKIA).

The HKLR project has been separated into two contracts. They are Contract No. HY/2011/03 Hong Kong-Zhuhai-Macao Bridge Hong Kong Link Road-Section between Scenic Hill and Hong Kong Boundary Crossing Facilities (hereafter referred to as the Contract) and Contract No. HY/2011/09 Hong Kong-Zhuhai-Macao Bridge Hong Kong Link Road-Section between HKSAR Boundary and Scenic Hill.

China State Construction Engineering (Hong Kong) Ltd. was awarded by Highways Department as the Contractor to undertake the construction works of Contract No. HY/2011/03. The main works of the Contract include land tunnel at Scenic Hill, tunnel underneath Airport Road and Airport Express Line, reclamation and tunnel to the east coast of the Airport Island, at-grade road connecting to the HKBCF and highway works of the HKBCF within the Airport Island and in the vicinity of the HKLR reclamation. The Contract is part of the HKLR Project and HKBCF Project, these projects are considered to be "Designated Projects", under Schedule 2 of the Environmental Impact Assessment (EIA) Ordinance (Cap 499) and Environmental Impact Assessment (EIA) Reports (Register No. AEIAR-144/2009 and AEIAR-145/2009) were prepared for the Project. The current Environmental Permit (EP) EP-352/2009/C for HKLR and EP-353/2009/G for HKBCF were issued on 5 September 2013 and 6 August 2013, respectively. These documents are available through the EIA Ordinance Register. The construction phase of Contract was commenced on 17 October 2012.

BMT Asia Pacific Limited has been appointed by the Contractor to implement the Environmental Monitoring & Audit (EM&A) programme for the Contract in accordance with the Updated EM&A Manual for HKLR (Version 1.0) and will be providing environmental team services to the Contract.

This is the Seventh Quarterly EM&A report for the Contract which summaries the monitoring results and audit findings of the EM&A programme during the reporting period from 1 March to 31 May 2014.

Environmental Monitoring and Audit Progress

The EM&A programme were undertaken in accordance with the Updated EM&A Manual for HKLR (Version 1.0). A summary of the monitoring activities during this reporting period is presented as below:

Monitoring Activity		Monitoring Date		
		March 2014	**April 2014**	**May 2014**
Air Quality	1-hr TSP	5, 11, 17, 21 and 27	2, 8, 14, 17, 23 and 29	5, 9, 15, 21, and 27
	24-hr TSP	4, 10, 14, 20 and 26	AMS5: 1, 7, 11, 16, 22 and 28 AMS6: 1, 14, 15, 16, 22 and 28	2, 8, 14, 20, 26 and 30
Noise		5, 11, 17 and 27	2, 8, 14, 23 and 29	5, 15, 21 and 29
Water Quality		3, 5, 7, 10, 12, 14, 17, 19, 21, 24, 26, 28 and 31	2, 4, 7, 9, 11, 14, 16, 18, 21, 23, 25, 28 and 30	2, 5, 7, 9, 12, 14, 16, 19, 21, 23, 26, 28 and 30
Chinese White Dolphin		5, 11, 17 and 25	4, 14, 16 and 24	2, 19, 21 and 26
Mudflat Monitoring (Ecology)		1, 2, 15, 16, 17 and 20	-	-
Mudflat Monitoring (Sedimentation rate)		17	-	-
Site Inspection		5, 12, 19 and 28	2, 9, 16, 25 and 30	7, 14, 21 and 30

Due to the windy condition, the dolphins monitoring schedule was rescheduled on 11, 17 and 25 March 2014.

The mudflat monitoring was rescheduled from 19 March 2014 to 20 March 2014 as the weather forecast indicated that the weather would be better on 20 March 2014 when compared to those of 19 March 2014.

The motor of high volume sampler (HVS) at AMS6 was malfunction on 7 April 2014. There was a problem with power supply for the HVS at AMS6 on 11 April 2014. Therefore, the dust monitoring on 7 and 11 April 2014 was rescheduled for 14 and 15 April 2014.

Due to boat availability issue, the dolphins monitoring schedule was rescheduled from 15 April 2014 for 14 April 2014, from 17 April 2014 for 16 April 2014, from 22 April 2014 for 24 April 2014, from 7 May 2014 for 2 May 2014, and from 13 May 2014 for 21 May 2014.

The noise monitoring on 27 May 2014 was rescheduled for 29 May 2014 due to the annual calibration.

Breaches of Action and Limit Levels

A summary of environmental exceedances for this reporting period is as follows:

Environmental Monitoring	Parameters	Action Level (AL)	Limit Level (LL)
Air Quality	1-hr TSP	0	0
	24-hr TSP	1	0
Noise	$L_{eq\ (30\ min)}$	0	0
Water Quality	Suspended solids level (SS)	13	2
	Turbidity level	0	0
	Dissolved oxygen level (DO)	0	0
Dolphin Monitoring	Quarterly Analysis (March to May 2014)	2	0

The Environmental Team investigated all exceedances and found that they were not project related.

All investigation reports for exceedances of the Contract have been submitted to ENPO/IEC for comments and/or follow up to identify whether the exceedances occurred related to other HZMB contracts.

Implementation of Mitigation Measures

Site inspections were carried out on a weekly basis to monitor the implementation of proper environmental pollution control and mitigation measures for the Project. Potential environmental impacts due to the construction activities were monitored and reviewed.

Complaint Log

A summary of environmental complaints for this reporting period is as follows:

Environmental Complaint No.	Date of Complaint Received	Description of Environmental Complaints
COM-2014-050	24 March 2014	Other: Dredged marine sediment
COM-2014-051	29 April 2014	Noise
COM-2014-052	2 May 2014	Noise

Notifications of Summons and Prosecutions

There were no notifications of summons or prosecutions received during this reporting period.

Reporting Changes

This report has been developed in compliance with the reporting requirements for the quarterly summary EM&A reports as required by the Updated EM&A Manual for HKLR (Version 1.0).

The proposal for the change of Action Level and Limit Level for suspended solid and turbidity was approved by EPD on 25 March 2013.

The revised Event and Action Plan for dolphin Monitoring was approved by EPD on 6 May 2013.

The original monitoring station at IS(Mf)9 (Coordinate- East:813273, North 818850) was observed inside the perimeter silt curtain of Contract HY/2010/02 on 1 July 2013, as such the original impact water quality monitoring location at IS(Mf)9 was temporarily shifted outside the silt curtain. As advised by the Contractor of HY/2010/02 in August 2013, the perimeter silt curtain was shifted to facilitate safe anchorage zone of construction barges/vessels until end of 2013 subject to construction progress. Therefore, water quality monitoring station IS(Mf)9 was shifted to 813226E and 818708N since 1 July 2013. According to the water quality monitoring team's observation on 24 March 2014, the original monitoring location of IS(Mf)9 was no longer enclosed by the perimeter silt curtain of Contract HY/2010/02. Thus, the impact water quality monitoring works at the original monitoring location of IS(Mf)9 has been resumed since 24 March 2014.

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1 Introduction

1.1 Basic Project Information

1.1.1 The Hong Kong-Zhuhai-Macao Bridge (HZMB) Hong Kong Link Road (HKLR) serves to connect the HZMB Main Bridge at the Hong Kong Special Administrative Region (HKSAR) Boundary and the HZMB Hong Kong Boundary Crossing Facilities (HKBCF) located at the north eastern waters of the Hong Kong International Airport (HKIA).

1.1.2 The HKLR project has been separated into two contracts. They are Contract No. HY/2011/03 Hong Kong-Zhuhai-Macao Bridge Hong Kong Link Road-Section between Scenic Hill and Hong Kong Boundary Crossing Facilities (hereafter referred to as the Contract) and Contract No. HY/2011/09 Hong Kong-Zhuhai-Macao Bridge Hong Kong Link Road-Section between HKSAR Boundary and Scenic Hill.

1.1.3 China State Construction Engineering (Hong Kong) Ltd. was awarded by Highways Department (HyD) as the Contractor to undertake the construction works of Contract No. HY/2011/03. The Contract is part of the HKLR Project and HKBCF Project, these projects are considered to be "Designated Projects", under Schedule 2 of the Environmental Impact Assessment (EIA) Ordinance (Cap 499) and Environmental Impact Assessment (EIA) Reports (Register No. AEIAR-144/2009 and AEIAR-145/2009) were prepared for the Project. The current Environmental Permit (EP) EP-352/2009/C for HKLR and EP-353/2009/G for HKBCF were issued on 5 September 2013 and 6 August 2013, respectively. These documents are available through the EIA Ordinance Register. The construction phase of Contract was commenced on 17 October 2012. **Figure 1.1** shows the project site boundary.

1.1.4 BMT Asia Pacific Limited has been appointed by the Contractor to implement the EM&A programme for the Contract in accordance with the Updated EM&A Manual for HKLR (Version 1.0) for HKLR and will be providing environmental team services to the Contract. ENVIRON Hong Kong Ltd. was employed by HyD as the Independent Environmental Checker (IEC) and Environmental Project Office (ENPO) for the Project. The project organization with regard to the environmental works is provided in **Appendix A**.

1.1.5 This is the Seventh Quarterly Environmental Monitoring and Audit (EM&A) report for the Contract which summaries the monitoring results and audit findings of the EM&A programme during the reporting period from 1 March to 31 May 2014.

1.2 Project Organisation

1.2.1 The project organization structure and lines of communication with respect to the on-site environmental management structure with the key personnel contact names and numbers are shown in **Appendix A**.

1.3 Construction Programme

1.3.1 A copy of the Contractor's construction programme is provided in **Appendix B**.

1.4 Construction Works Undertaken During the Reporting Period

1.4.1 A summary of the construction activities undertaken during this reporting period is shown in **Table 1.1**. The Works areas of the Contract are showed in **Appendix C**.

Table 1.1 Construction Activities during Reporting Period

Site Area	Description of Activities
Portion X	• Stone column installation • Filling works behind stone platform • Temporary stone platform construction • Band drains installation • Dismantling/trimming of temporary 40mm stone platform for construction of seawall • Piling Works
Portion Y	• Access shaft construction for Scenic Hill Tunnel (SHT) & HKBCF to Airport Tunnel (HAT) • Utility culvert excavation • Pipe piling works for depressed roundabout
West Portal	• Pipe roofing installation and excavation of SHT
Kwo Lo Wan /Airport Road	• Works for diversion of Airport Road and Kwo Lo Wan Road
Airport Express Line	• Pre-grouting and pipe piling works for Airport Express Line (AEL) access shafts
Kwo Lo Wan /Airport Road /Airport Express Line	• Utilities detection • Establishment of site access • Works for east access shaft

2 EM&A Requirement

2.1 Summary of EM&A Requirements

2.1.1 The EM&A programme requires environmental monitoring of air quality, noise, water quality, dolphin monitoring and mudflat monitoring as specified in the approved EM&A Manual.

2.1.2 A summary of Impact EM&A requirements is presented in **Table 2.1**. The locations of air quality, noise and water quality monitoring stations are shown as in **Figure 2.1**. The transect line layout in Northwest and Northeast Lantau Survey Areas is presented in **Figure 2.2**.

Table 2.1 Summary of Impact EM&A Requirements

Environmental Monitoring	Description	Monitoring Station	Frequencies	Remarks
Air Quality	1-hr TSP	AMS 5 & AMS 6	At least 3 times every 6 days	While the highest dust impact was expected.
	24-hr TSP		At least once every 6 days	--
Noise	$L_{eq\ (30mins)}$, $L_{10\ (30mins)}$ and $L_{90\ (30mins)}$	NMS5	At least once per week	Daytime on normal weekdays (0700-1900 hrs).
Water Quality	• Depth • Temperature • Salinity • Dissolved Oxygen (DO) • Suspended Solids (SS) • DO Saturation • Turbidity • pH	• Impact Stations: IS5, IS(Mf)6, IS7, IS8, IS(Mf)9 & IS10, • Control/Far Field Stations: CS2 & CS(Mf)5, • Sensitive Receiver Stations: SR3, SR4, SR5, SR10A & SR10B	Three times per week during mid-ebb and mid-flood tides (within ± 1.75 hour of the predicted time)	3 (1 m below water surface, mid-depth and 1 m above sea bed, except where the water depth is less than 6 m, in which case the mid-depth station may be omitted. Should the water depth be less than 3 m, only the mid-depth station will be monitored).
Dolphin	Line-transect Methods	Northeast Lantau survey area and Northwest Lantau survey area	Twice per month	--
Mudflat	Horseshoe crabs, seagrass beds, intertidal soft shore communities, sedimentation rates and water quality	San Tau and Tung Chung Bay	Once every 3 months	--

2.2 Action and Limit Levels

2.2.1 **Table 2.2** presents the Action and Limit Levels for the 1-hour TSP, 24-hour TSP and noise level.

Table 2.2 Action and Limit Levels for 1-hour TSP, 24-hour TSP and Noise

Environmental Monitoring	Parameters	Monitoring Station	Action Level	Limit Level
Air Quality	1-hr TSP	AMS 5	352 μg/m^3	500 μg/m^3
		AMS 6	360 μg/m^3	
	24-hr TSP	AMS 5	164 μg/m^3	260 μg/m^3
		AMS 6	173 μg/m^3	
Noise	$L_{eq\ (30\ min)}$	NMS 5	When one documented complaint is received	75 dB(A)

2.2.2 The Action and Limit Levels for water quality monitoring are given as in **Table 2.3**.

Table 2.3 Action and Limit Levels for Water Quality

Parameter (unit)	Water Depth	Action Level	Limit Level
Dissolved Oxygen (mg/L)	Surface and Middle	5.0	4.2 except 5 for Fish Culture Zone
	Bottom	4.7	3.6
Turbidity (NTU)	Depth average	27.5 or 120% of upstream control station's turbidity at the same tide of the same day; The action level has been amended to "27.5 ***and*** 120% of upstream control station's turbidity at the same tide of the same day" since 25 March 2013.	47.0 or 130% of turbidity at the upstream control station at the same tide of same day; The limit level has been amended to "47.0 ***and*** 130% of turbidity at the upstream control station at the same tide of same day" since 25 March 2013.
Suspended Solid (SS) (mg/L)	Depth average	23.5 or 120% of upstream control station's SS at the same tide of the same day; The action level has been amended to "23.5 ***and*** 120% of upstream control station's SS at the same tide of the same day" since 25 March 2013.	34.4 or 130% of SS at the upstream control station at the same tide of same day and 10mg/L for Water Services Department Seawater Intakes; The limit level has been amended to "34.4 ***and*** 130% of SS at the upstream control station at the same tide of same day and 10mg/L for Water Services Department Seawater Intakes" since 25 March 2013

Notes:
(1) Depth-averaged is calculated by taking the arithmetic means of reading of all three depths.
(2) For DO, non-compliance of the water quality limit occurs when monitoring result is lower that the limit.
(3) For SS & turbidity non-compliance of the water quality limits occur when monitoring result is higher than the limits.
(4) The change to the Action and limit Levels for Water Quality Monitoring for the EM&A works was approved by EPD on 25 March 2013. Therefore, the amended Action and Limit Levels are applied for the water monitoring results obtained on and after 25 March 2013.

2.2.3 The Action and Limit Levels for dolphin monitoring are shown in **Tables 2.4 and 2.5**.

Table 2.4 Action and Limit Level for Dolphin Impact Monitoring

	North Lantau Social Cluster	
	NEL	**NWL**
Action Level	STG < 70% of baseline & ANI < 70% of baseline	STG < 70% of baseline & ANI < 70% of baseline
Limit Level	STG < 40% of baseline & ANI < 40% of baseline	

Remarks:

(1) STG means quarterly average encounter rate of number of dolphin sightings.
(2) ANI means quarterly average encounter rate of total number of dolphins.
(3) For North Lantau Social Cluster, AL will be trigger if either NEL or NWL fall below the criteria; LL will be triggered if both NEL and NWL fall below the criteria.

Table 2.5 Derived Value of Action Level (AL) and Limit Level (LL)

	North Lantau Social Cluster	
	NEL	**NWL**
Action Level	STG < 4.2 & ANI < 15.5	STG < 6.9 & ANI < 31.3
Limit Level	(STG < 2.4 & ANI < 8.9) and (STG < 3.9 & ANI < 17.9)	

Remarks:

(1) STG means quarterly average encounter rate of number of dolphin sightings.
(2) ANI means quarterly average encounter rate of total number of dolphins.
(3) For North Lantau Social Cluster, AL will be trigger if either NEL or NWL fall below the criteria; LL will be triggered if both NEL and NWL fall below the criteria.

2.3 Event Action Plans

2.3.1 The Event Actions Plans for air quality, noise, water quality and dolphin monitoring are annexed in **Appendix D.**

2.4 Mitigation Measures

2.4.1 Environmental mitigation measures for the contract were recommended in the approved EIA Report. **Appendix E** lists the recommended mitigation measures and the implementation status.

3 Environmental Monitoring and Audit

3.1 Implementation of Environmental Measures

3.1.1 In response to the site audit findings, the Contractors carried out corrective actions. Details of site audit findings and the corrective actions during the reporting period are presented in **Appendix F**.

3.1.2 A summary of the Implementation Schedule of Environmental Mitigation Measures (EMIS) is presented in **Appendix E**.

3.1.3 Regular marine travel route for marine vessels were implemented properly in accordance to the submitted plan and relevant records were kept properly.

3.1.4 Dolphin Watching Plan was implemented during the reporting period. No dolphins inside the silt curtain were observed. The relevant records were kept properly.

3.2 Air Quality Monitoring Results

3.2.1 The monitoring results for 1-hour TSP and 24-hour TSP are summarized in **Tables 3.1** and **3.2** respectively. Detailed impact air quality monitoring results and relevant graphical plots are presented in **Appendix G**.

Table 3.1 Summary of 1-hour TSP Monitoring Results During the Reporting Period

Reporting Period	Monitoring Station	Average ($\mu g/m^3$)	Range ($\mu g/m^3$)	Action Level ($\mu g/m^3$)	Limit Level ($\mu g/m^3$)
March 2014	AMS5	101	19 – 275	352	500
	AMS6	68	21 – 144	360	
April 2014	AMS5	65	10 – 203	352	
	AMS6	46	16 – 118	360	
May 2014	AMS5	19	9 – 36	352	
	AMS6	21	15 – 32	360	

Table 3.2 Summary of 24-hour TSP Monitoring Results During the Reporting Period

Reporting Period	Monitoring Station	Average ($\mu g/m^3$)	Range ($\mu g/m^3$)	Action Level ($\mu g/m^3$)	Limit Level ($\mu g/m^3$)
March 2014	AMS5	97	47 – 136	164	260
	AMS6	121	74 – 190	173	
April 2014	AMS5	63	51 – 86	164	
	AMS6	86	56 – 158	173	
May 2014	AMS5	26	19 – 35	164	
	AMS6	46	28 – 86	173	

3.2.2 For 1-hr TSP, no Action and Limit Level exceedances were reocorded for air during daytime on normal weekdays of the reporting period.

3.2.3 For 24-hr TSP, one Action level exceedance was recorded at station AMS6 on 20 March 2014.

3.2.4 The general weather conditions at Tung Chung were foggy and haze during the dust sampling period on 20 March 2014. The Air Quality Health Index (AQHI) recorded by EPD at the Tung Chung station during the sampling time ranged from 3 (low) to 8 (very high). Therefore, it was considered that the exceedance was not related to the construction activities of the Contract and was caused by poor weather..

3.3 Noise Monitoring Results

3.3.1 The monitoring results for construction noise are summarized in **Table 3.3** and the monitoring results and relevant graphical plots for this reporting period are provided in **Appendix H.**

Table 3.3 Summary of Construction Noise Monitoring Results During the Reporting Period

Reporting period	Monitoring Station	Average $L_{eq\ (30\ mins)}$, dB(A)*	Range of $L_{eq\ (30\ mins)}$, dB(A)*	Action Level	Limit Level $L_{eq\ (30\ mins)}$, dB(A)
March 2014	NMS5	60	59 – 60	When one documented complaint is received	75
April 2014		60	58 – 62		
May 2014		59	56 – 61		

*A correction factor of +3dB(A) from free field to facade measurement was included.

3.3.2 There were no Action and Limit Level exceedances for noise during daytime on normal weekdays of the reporting period.

3.3.3 Major noise sources during the noise monitoring included construction activities of the Contract and nearby traffic noise.

3.4 Water Quality Monitoring Results

3.4.1 Impact water quality monitoring was conducted at all designated monitoring stations during the reporting period. Impact water quality monitoring results and relevant graphical plots are provided in **Appendix I**.

3.4.2 During the reporting period, there were thirteen Action Level exceedances and two Limit Level exceedances of suspended solids level.

3.4.3 Water quality impact sources during the water quality monitoring were the construction activities of the Contract, nearby construction activities by other parties and nearby operating vessels by other parties.

3.5 Dolphin Monitoring Results

Data Analysis

3.5.1 Distribution Analysis – The line-transect survey data was integrated with the Geographic Information System (GIS) in order to visualize and interpret different spatial and temporal patterns of dolphin distribution using sighting positions. Location data of dolphin groups were plotted on map layers of Hong Kong using a desktop GIS (ArcView© 3.1) to examine their distribution patterns in details. The dataset was also stratified into different subsets to examine distribution patterns of dolphin groups with different categories of group sizes, young calves and activities.

3.5.2 Encounter rate analysis – Encounter rates of Chinese White Dolphins (number of on-effort sightings per 100 km of survey effort, and total number of dolphins sighted on-effort per 100 km of survey effort) were calculated in NEL and NWL survey areas in relation to the amount of survey effort conducted during each month of monitoring survey. Dolphin encounter rates were calculated in two ways for comparisons with the HZMB baseline monitoring results as well as to AFCD long-term marine mammal monitoring results.

3.5.3 Firstly, for the comparison with the HZMB baseline monitoring results, the encounter rates were calculated using primary survey effort alone, and only data collected under Beaufort 3 or below condition would be used for encounter rate analysis. The average encounter rate of sightings (STG) and average encounter rate of dolphins (ANI) were deduced based on the encounter rates from six events during the present quarter (i.e. six sets of line-transect surveys in North Lantau), which was also compared with the one deduced from the six events during the baseline period (i.e. six sets of line-transect surveys in North Lantau).

3.5.4 Secondly, the encounter rates were calculated using both primary and secondary survey effort collected under Beaufort 3 or below condition as in AFCD long-term monitoring study. The encounter rate of sightings and dolphins were deduced by dividing the total number of on-effort sightings and total number of dolphins (ANI) by the amount of survey effort for the entire quarterly period (March – May 2014).

3.5.5 Quantitative grid analysis on habitat use – To conduct quantitative grid analysis of habitat use, positions of on-effort sightings of Chinese White Dolphins collected during the quarterly impact phase monitoring period were plotted onto 1-km^2 grids among Northwest Lantau (NWL) and Northeast (NEL) survey areas on GIS. Sighting densities (number of on-effort sightings per km^2) and dolphin densities (total number of dolphins from on-effort sightings per km^2) were then calculated for each 1 km by 1 km grid with the aid of GIS. Sighting density grids and dolphin density grids were then further normalized with the amount of survey effort conducted within each grid. The total amount of survey effort spent on each grid was calculated by examining the survey coverage on each line-transect survey to determine how many times the grid was surveyed during the study period. For example, when the survey boat traversed through a specific grid 50 times, 50 units of survey effort were counted for that grid. With the

amount of survey effort calculated for each grid, the sighting density and dolphin density of each grid were then normalized (i.e. divided by the unit of survey effort).

3.5.6 The newly-derived unit for sighting density was termed SPSE, representing the number of on-effort sightings per 100 units of survey effort. In addition, the derived unit for actual dolphin density was termed DPSE, representing the number of dolphins per 100 units of survey effort. Among the 1-km^2 grids that were partially covered by land, the percentage of sea area was calculated using GIS tools, and their SPSE and DPSE values were adjusted accordingly. The following formulae were used to estimate SPSE and DPSE in each 1-km^2 grid within the study area:

$$SPSE = ((S / E) \times 100) / SA\%$$
$$DPSE = ((D / E) \times 100) / SA\%$$

where S = total number of on-effort sightings
D = total number of dolphins from on-effort sightings
E = total number of units of survey effort
SA% = percentage of sea area

3.5.7 Behavioural analysis – When dolphins were sighted during vessel surveys, their behaviour was observed. Different activities were categorized (i.e. feeding, milling/resting, traveling, socializing) and recorded on sighting datasheets. This data was then input into a separate database with sighting information, which can be used to determine the distribution of behavioural data with a desktop GIS. Distribution of sightings of dolphins engaged in different activities and behaviours would then be plotted on GIS and carefully examined to identify important areas for different activities of the dolphins.

3.5.8 Ranging pattern analysis – Location data of individual dolphins that occurred during the 3-month baseline monitoring period were obtained from the dolphin sighting database and photo-identification catalogue. To deduce home ranges for individual dolphins using the fixed kernel methods, the program Animal Movement Analyst Extension, was loaded as an extension with ArcView© 3.1 along with another extension Spatial Analyst 2.0. Using the fixed kernel method, the program calculated kernel density estimates based on all sighting positions, and provided an active interface to display kernel density plots. The kernel estimator then calculated and displayed the overall ranging area at 95% UD level.

Summary of Survey Effort and Dolphin Sightings

3.5.9 During the period of March to May 2014, six sets of systematic line-transect vessel surveys were conducted to cover all transect lines in NWL and NEL survey areas twice per month.

3.5.10 From these surveys, a total of 891.87 km of survey effort was collected with 87.4% of the total survey effort being conducted under favourable weather conditions (i.e. Beaufort Sea State 3 or below with good visibility). Among the two areas, 350.40 km and 541.47 km of survey effort were conducted in NEL and NWL survey areas respectively.

3.5.11 The total survey effort conducted on primary lines was 642.67 km, while the effort on secondary lines was 249.20 km. Both survey effort conducted on primary and secondary lines were considered as on-effort survey data. Summary table of the survey effort is shown in **Annex I of Appendix J**.

3.5.12 During the six sets of monitoring surveys in March to May 2014, a total of 31 groups of 103 Chinese White Dolphins were sighted. All except one sighting were made during on-effort search. Twenty-five on-effort sightings were made on primary lines, while another five on-effort sightings were made on secondary lines. In this quarterly period, all dolphin groups were sighted in NWL, while none was sighted in NEL Summary table of the dolphin sightings is shown in **Annex II of Appendix J**.

Distribution

3.5.13 Distribution of dolphin sightings made during monitoring surveys in March, April and May 2014 was shown in **Figure 1 of Appendix J** . Consistent with the dolphin distribution patterns in the previous quarterly periods, the majority of dolphin sightings were made in the northwestern portion of the North Lantau region. Dolphin sightings were particularly concentrated to the northern and northwestern sides of Lung Kwu Chau, and at the mouth of Deep Bay near Black Point (Figure 1). Other dolphin sightings were scattered between Lung Kwu Chau and Sha Chau, near Pillar Point, Tap Shek Kok and the airport platform. No dolphin was sighted in NEL survey area during the present quarterly period **(Figure 1 of Appendix J)**.

3.5.14 None of the dolphin groups were sighted in the vicinity of the HKLR03/ HKBCF reclamation sites or along the entire alignment of Tuen Mun-Chek Lap Kok Link (TMCLKL) **(Figure 1 of Appendix J)**.

3.5.15 Sighting distribution of the present impact phase monitoring period (March to May 2014) was compared to the one during the baseline monitoring period (September to November 2011). During the present quarter, dolphin disappeared from the NEL region, which was in stark contrast to their frequent occurrence around the Brothers Islands and in the vicinity of HKBCF reclamation site during the baseline period **(Figure 1 of Appendix J)**.

3.5.16 Dolphin occurrence in the northwestern portion of North Lantau region was largely similar between the baseline and impact phase quarters. However, during the present impact monitoring period, there appeared to be much fewer dolphins occurred in the middle portion of North Lantau region, where dolphins supposedly moved between their core areas around Lung Kwu Chau and the Brothers Islands **(Figure 1 of Appendix J).** Moreover, a number of dolphin sightings were made to the west of Chek Lap Kok airport (especially near the HKLR09 alignment) during the baseline period, but only one sighting was made there during the present impact phase period.

3.5.17 As the baseline monitoring period was in autumn season while the present monitoring period was in spring season, a direct comparison in dolphin distribution between the two quarterly periods of spring months in 2013 and 2014 was also made to avoid the potential bias in seasonal variation **(Figure 2 of Appendix J)**. Between the two spring periods, none of the dolphin sightings was made in NEL in spring 2014, while there were two sightings made in spring 2013. Moreover, more dolphin sightings were made in the middle portion of North Lantau waters and to the west of the airport platform (especially near the HKLR09 alignment) in spring 2013 than in spring 2014.

Encounter Rate

3.5.18 For the three-month study period in March, April and May 2014, the encounter rates of Chinese White Dolphins deduced from the survey effort and on-effort sighting data from the primary transect lines under favourable conditions (Beaufort 3 or below) from each of the survey areas are shown in **Table 3.4**. The average encounter rates deduced from the six sets of surveys were also compared with the ones deduced from the baseline monitoring period in September to November 2011 (See **Table 3.5**).

Table 3.4 Dolphin Encounter Rates (Sightings Per 100 km of Survey Effort) During three Reporting Period (Mar – May 2014)

Survey Area	Dolphin Monitoring	Encounter rate (STG) (no. of on-effort dolphin sightings per 100 km of survey effort)	Encounter rate (ANI) (no. of dolphins from all on-effort sightings per 100 km of survey effort)
		Primary Lines Only	Primary Lines Only
Northeast Lantau	Set 1 (5 & 11 Mar 2014)	0.00	0.00
	Set 2 (17 & 25 Mar 2014)	0.00	0.00
	Set 3 (4 & 14 Apr 2014)	0.00	0.00

	Set 4 (16 & 24 Apr 2014)	0.00	0.00
	Set 5 (2 & 19 May 2014)	0.00	0.00
	Set 6 (21 & 26 May 2014)	0.00	0.00
Northwest Lantau	Set 1 (5 & 11 Mar 2014)	6.43	23.57
	Set 2 (17 & 25 Mar 2014)	13.15	24.83
	Set 3 (4 & 14 Apr 2014)	4.89	26.88
	Set 4 (16 & 24 Apr 2014)	4.94	11.54
	Set 5 (2 & 19 May 2014)	5.47	18.24
	Set 6 (21 & 26 May 2014)	4.18	9.75

Table 3.5 Comparison of Average Dolphin Encounter Rates between Reporting Period (Mar –May 2014) and Baseline Monitoring Period (Sep – Nov 2011)

Survey Area	Encounter rate (STG) (no. of on-effort dolphin sightings per 100 km of survey effort)		Encounter rate (ANI) (no. of dolphins from all on-effort sightings per 100 km of survey effort)	
	Reporting Period	Baseline Monitoring Period	Reporting Period	Baseline Monitoring Period
Northeast Lantau	0.00	6.00 ± 5.05	0.00	22.19 ± 26.81
Northwest Lantau	6.51 ± 3.34	9.85 ± 5.85	19.14 ± 7.19	44.66 ± 29.85

Note:
The encounter rates deduced from the baseline monitoring period have been recalculated based only on the survey effort and on-effort sighting data made along the primary transect lines under favourable conditions)

3.5.19 To facilitate the comparison with the AFCD long-term monitoring results, the encounter rates were also calculated for the present quarter using both primary and secondary survey effort. The encounter rates of sightings (STG) and dolphins (ANI) in NWL were 6.00 sightings and 17.34 dolphins per 100 km of survey effort respectively, while the encounter rates of sightings (STG) and dolphins (ANI) in NEL were both zero as no sighting was made in this area.

3.5.20 In NEL, the average dolphin encounter rates (both STG and ANI) in the present three-month impact phase were zero, which was the lowest since the HKLR03 dolphin monitoring commenced in October 2012. Notably, dolphin encounter rates in spring 2013 were also exceptionally low (Table 4), but dolphin occurrence have even worsened in spring 2014.

3.5.21 It is a serious concern that dolphin occurrence in NEL in the past five quarters (0.0-1.0 for ER(STG) and 0.0-3.9 for ER(ANI)) have been exceptionally low when compared to the baseline period (**Table 3.6**). In fact, the present quarter was the sixth consecutive quarters being accessed that have triggered the Action Level under the Event and Action Plan. As discussed recently in Hung (2014), the dramatic decline in dolphin usage of NEL waters in 2012 and 2013 (including decline in abundance, encounter rate and habitat use, as well as shifts of individual core areas and ranges away from NEL waters) was possibly related to the HZMB construction works that were commenced in 2012.

3.5.22 On the other hand, the average dolphin encounter rates (STG and ANI) in NWL during the present impact phase monitoring period were much lower (reductions of 34% and 57% respectively) than the ones recorded in the 3-month baseline period, indicating a reduced dolphin usage of this survey area during the present construction period. In fact, both

encounter rates in spring 2014 were lower than ones in the previous five quarterly periods. (**Table 3.7**).

Table 3.6 Comparison of Average Dolphin Encounter Rates in Northeast Lantau Survey Area from All Quarters of Impact Monitoring Period and Baseline Monitoring Period (Sep – Nov 2011)

	Encounter rate (STG) (no. of on-effort dolphin sightings per 100 km of survey effort)	**Encounter rate (ANI) (no. of dolphins from all on-effort sightings per 100 km of survey effort)**
September-November 2011 (Baseline)	6.00 ± 5.05	22.19 ± 26.81
December 2012-February 2013 (Impact)	3.14 ± 3.21	6.33 ± 8.64
March-May 2013 (Impact)	0.42 ± 1.03	0.42 ± 1.03
June-August 2013 (Impact)	0.88 ± 1.36	3.91 ± 8.36
September-November 2013 (Impact)	1.01 ± 1.59	3.77 ± 6.49
December 2013-February 2014 (Impact)	0.45 ± 1.10	1.34 ± 3.29
March-May 2014 (Impact)	0.00	0.00

Note:
The encounter rates deduced from the baseline monitoring period have been recalculated based only on survey effort and on-effort sighting data made along the primary transect lines under favourable conditions.

Table 3.7 Comparison of Average Dolphin Encounter Rates in Northwest Lantau Survey Area from All Quarters of Impact Monitoring Period and Baseline Monitoring Period (Sep – Nov 2011)

	Encounter rate (STG) (no. of on-effort dolphin sightings per 100 km of survey effort)	**Encounter rate (ANI)** (no. of dolphins from all on-effort sightings per 100 km of survey effort)
September-November 2011 (Baseline)	9.85 ± 5.85	44.66 ± 29.85
December 2012-February 2013 (Impact)	8.36 ± 5.03	35.90 ± 23.10
March-May 2013 (Impact)	7.75 ± 3.96	24.23 ± 18.05
June-August 2013 (Impact)	6.56 ± 3.68	27.00 ± 18.71
September-November 2013 (Impact)	8.04 ± 1.10	32.48 ± 26.51
December 2013-February 2014 (Impact)	8.21 ± 2.21	32.58 ± 11.21
March-May 2014 (Impact)	6.51 ± 3.34	19.14 ± 7.19

Note: The encounter rates deduced from the baseline monitoring period have been recalculated based only on survey effort and on-effort sighting data made along the primary transect lines under favourable conditions.

3.5.23 A two-way ANOVA with repeated measures and unequal sample size was conducted to examine whether there were any significant differences in the average encounter rates

between the baseline and impact monitoring periods. The two variables that were examined included the two periods (baseline and impact phases) and two locations (NEL and NWL).

3.5.24 For the comparison between the baseline period and the present quarter (sixth quarter of the impact phase being assessed), the p-value for the differences in average dolphin encounter rates of STG and ANI were 0.0337 and 0.0535 respectively. If the alpha value is set at 0.1, significant difference was detected between the baseline and present quarters in both dolphin encounter rates of STG and ANI.

3.5.25 For the comparison between the baseline period and the cumulative quarters in impact phase (i.e. first six quarters of the impact phase being assessed), the p-value for the differences in average dolphin encounter rates of STG and ANI were 0.0080 and 0.0032 respectively. Even if the alpha value is set at 0.01, significant differences were detected in both the average dolphin encounter rates of STG and ANI (i.e. between the two periods and the locations)

3.5.26 As indicated in both dolphin distribution patterns and encounter rates, dolphin usage has been significantly reduced in NEL waters (especially around the Brothers Islands and Shum Shui Kok) in the present quarterly period, and such low occurrence has been consistently documented in previous quarters. This raises serious concern, as the decline in dolphin usage could possibly link to the HZMB-related construction activities in NEL waters, which include the 150 hectares of habitat loss due to HKBCF reclamation, 23 hectares of habitat loss due to HKLR03 reclamation, as well as the recently commenced TMCLKL construction that involves intensive bored piling activities for the southern viaduct and further reclamation of 16.5 hectares for the northern landfall.

3.5.27 To ensure the continuous usage of NEL waters by the dolphins, every possible measure should be implemented by the contractors and relevant authorities to minimize all disturbances to the dolphins, as a future marine park around the Brothers Islands will be established in this important dolphin habitat as a compensation measure for the habitat loss resulted from the HKBCF reclamation works Unless such declining trend can be reverted after the establishment of the Brothers Islands Marine Park, there should be a presumption against further reclamation in North Lantau waters as suggested in Hung (2013, 2014).

Group Size

3.5.28 Group size of Chinese White Dolphins ranged from 1-13 individuals per group in North Lantau region during March – May 2014. The average dolphin group sizes from these three months were compared with the ones deduced from the baseline period in September to November 2011, as shown in **Table 3.8**.

Table 3.8 Comparison of Average Dolphin Group Sizes between Reporting Period (Mar – May 2014) and Baseline Monitoring Period (Sep– Nov 2011)

	Average Dolphin Group Size	
	Reporting Period	**Baseline Monitoring Period**
Overall	3.32 ± 2.87 (n = 31)	3.72 ± 3.13 (n = 66)
Northeast Lantau	0.0	3.18 ± 2.16 (n = 17)
Northwest Lantau	3.32 ± 2.87 (n = 31)	3.92 ± 3.40 (n = 49)

3.5.29 The average dolphin group sizes in the entire North Lantau region as well as in NWL waters during March – May 2014 were lower than the ones recorded during the three-month baseline period. **(Table 3.8)**. In fact, 21 of the 31 groups were composed of 1-3 individuals only, while only one group of dolphins was composed of more than 10 individuals.

3.5.30 Distribution of dolphins with larger group sizes (five individuals or more per group) during the present quarter is shown in **Figure 3 of Appendix J**, with comparison to the one in baseline period. In spring 2014, all larger dolphin groups were clustered to the south and north of Lung Kwu Chau **(Figure 3 of Appendix J)**. This distribution pattern was quite different from the baseline period, when the larger dolphin groups were distributed more evenly in NWL waters and a few more in NEL waters with no particular concentration **(Figure 3 of Appendix J)**. Notably none of the larger dolphin groups were sighted near the HKLR03 reclamation site in the present monitoring period. **(Figure 3 of Appendix J)**.

Habitat Use

3.5.31 From March to May 2014, the most heavily utilized habitats by Chinese White Dolphins mainly concentrated to the north and northeast of Lung Kwu Chau. **(Figures 4a and 4b of Appendix J)**. None of the grids in NEL recorded the presence of dolphins. Moreover, all grids near HKLR03/HKBCF reclamation sites, HKLR09 or TMCLKL alignment did not record any presence of dolphins during on-effort search in the present quarterly period.

3.5.32 However, it should be emphasized that the amount of survey effort collected in each grid during the three-month period was fairly low (6-12 units of survey effort for most grids), and therefore the habitat use pattern derived from the three-month dataset should be treated with caution. A more complete picture of dolphin habitat use pattern will be presented when more survey effort for each grid will be collected throughout the impact phase monitoring programme.

3.5.33 When compared with the habitat use patterns during the baseline period, dolphin usage in NEL was dramatically different from the present impact monitoring period **(Figure 5 of Appendix J)**. During the baseline period, nine grids between Siu Mo To and Shum Shui Kok recorded moderately high to high dolphin densities, which was in contrast to the complete absence of dolphins during the present impact phase period **(Figure 5 of Appendix J)**. On the other hand, the density patterns between the baseline and impact phase monitoring periods were also different in NWL, with higher dolphin usage near Sha Chau, between Pillar Point and airport platform, and along the west boundary of Hong Kong territorial waters during the baseline period **(Figure 5 of Appendix J)**.

3.5.34 The absence of dolphins in the identified important habitats around the Brothers Islands and Shum Shui Kok in consecutive quarters in 2013-14 is of serious concern. The future Brothers Islands Marine Park will be established in this area upon the completion of HKBCF reclamation works, as an important compensation measure for the associated habitat loss. As suggested recently in Hung (2014), such low usage of dolphins in this important habitat in the past two years was possibly related to the on-going HZMB-related construction works. Continuous monitoring of such diminished use should be continued in this important dolphin habitat in the upcoming quarters.

Mother-calf Pairs

3.5.35 During the three-month study period, a total of five unspotted juveniles (UJ) were sighted in NWL survey areas. These young calves comprised of 4.9% of all animals sighted, which was lower than the percentage recorded during the baseline monitoring period (6.8%).

3.5.36 These young calves were only present near Lung Kwu Chau or at the mouth of Deep Bay **(Figure 6 of Appendix J)**, which was very different from their distribution pattern during the baseline period when young calves were sighted throughout the NWL survey area as well as a few sighted in NEL waters. None of these young calves were sighted in the vicinity of the HKBCF/HKLR03 reclamation sites and HKLR09/TMCLKL alignments during the present quarter **(Figure 6 of Appendix J)**.

Activities and Associations with Fishing Boats

3.5.37 A total of five dolphin sightings were associated with feeding and socializing activities during the three-month study period. The percentage of feeding activities comprised of 9.7% of the

total number of dolphin sightings, which was slightly lower than the one recorded during the baseline period (11.6%). On the contrary, the percentage of socializing activities during the present impact phase monitoring period (6.5%) was slightly higher than the one recorded during the baseline period (5.4%). None of the dolphin groups was engaged in traveling or milling/resting activity during the present impact monitoring periods.

3.5.38 Distribution of dolphins engaged in feeding and socializing activities during the present three-month period is shown in **Figure 7 of Appendix J**. The sightings associated with these activities were only found near Lung Kwu Chau but not elsewhere in North Lantau waters, which was drastically different from the distribution pattern of these activities during the baseline period **(Figure 7 of Appendix J)**.

3.5.39 During the three-month period, none of the 31 dolphin groups was found to be associated with an operating fishing vessels in North Lantau waters. The rare events of fishing boat association in the present and previous quarters were consistently found, and were likely related to the recent trawl ban being implemented in December 2012 in Hong Kong waters.

Photo-identification and Individual Range Use

3.5.40 From March to May 2014, over 3,000 digital photographs of Chinese White Dolphins were taken during the impact phase monitoring surveys for the photo-identification work.

3.5.41 In total, 45 individuals sighted 74 times altogether were identified (see summary table in **Annex III of Appendix J** and photographs of identified individuals in **Annex IV of Appendix J**). All of these re-sightings were made in NWL.

3.5.42 Most identified individuals were sighted only once or twice during the three-month period, with the exception of six individuals being sighted thrice, and another two individuals (NL48 and NL261) being sighted four to five times on different survey days during the three-month period.

3.5.43 Notably six of these 45 individuals (i.e. NL33, NL182, NL295, WL04, WL05 and WL199) were also sighted in West Lantau waters during the HKLR09 monitoring surveys during the same three-month period, showing their extensive movement between North and West Lantau regions.

3.5.44 Six well-recognized females (NL33, NL46, NL104, NL145, NL202 and NL233) were accompanied with their calves during their re-sightings. All of these mothers were frequently sighted with their calves throughout the HKLR03 impact phase monitoring period since October 2012.

3.5.45 Ranging patterns of the 45 individuals identified during the three-month study period were determined by fixed kernel method, and are shown in **Annex V of Appendix J**.

3.5.46 All individuals sighted in this quarter were utilizing their range use in NWL (especially around Lung Kwu Chau) but have avoided NEL, where some of these individuals have utilized as their core areas in the past **(Annex V of Appendix J)**. This is in contrary to the extensive movements between NEL and NWL survey areas observed in the earlier impact monitoring quarters as well as during the baseline period.

3.5.47 For many individuals that have previously utilized the Brothers Islands as their major core area of activities, they have apparently shifted their range use away from this important habitat (e.g. EL01, NL24, NL33, NL120, NL191, NL260; Annex V of Appendix J). Such shifts of range use and core area use were also well documented by Hung (2014).

3.5.48 The diminished or abandoned usage of NEL waters by a large number of individual dolphins coincided well with the noticeable decline in dolphin occurrence in NEL as discussed in Sections 3.5.13 to 3.5.27. This is of serious concern, as the Brothers Islands in NEL was once identified an important habitat for many year-round residents that focused their core area use there (Hung 2008, 2013). Therefore, the ranging pattern of individual dolphins should be continuously monitored around Lantau waters, and measures should be taken to ensure that

dolphins will continue to move between NWL and NEL without any hindrance as a result of the HZMB-related construction works

Action Level / Limit Level Exceedance

3.5.49 There was two Action Level exceedance of dolphin monitoring for the quarterly monitoring data (March – May 2014). According to the contractor's information, the marine activities undertaken for HKLR03 during the two quarterly periods (December 2013 to February 2014 and March 2014 to May 2014) included stone platform construction, reclamation, stone column installation and excavation of stone platform, surcharge activities, construction of seawall and geotextile tube installation works. There is no evidence showing the current AL non-compliance directly related to the construction works of HKLR03, although the generally increased amount of vessel traffic in NEL during the impact phase has been partly contributed by HKLR03 works since October 2012. It should also be noted that reclamation work under HKLR03 (adjoining the Airport Island) situates in waters which has rarely been used by dolphins in the past, and the working vessels under HKLR03 have been travelling from source to destination in accordance with the Marine Travel Route to minimize impacts on Chinese White Dolphin. In addition, the contractor will implement proactive mitigation measures such as avoiding anchoring at Marine Department's designated anchorage site – Sham Shui Kok Anchorage (near Brothers Island) as far as practicable.

3.5.50 A two-way ANOVA with repeated measures and unequal sample size was conducted to examine whether there were any significant differences in the average encounter rates between the baseline and impact monitoring periods. The two variables that were examined included the two periods (baseline and impact phases) and two locations (NEL and NWL)).

3.5.51 For the comparison between the baseline period and the present quarter (sixth quarter of the impact phase being assessed),), the p-value for the differences in average dolphin encounter rates of STG and ANI were 0.0337 and 0.0535 respectively. If the alpha value is set at 0.1, significant difference was detected between the baseline and present quarters in both encounter rates of STG and ANI.

3.5.52 For the comparison between the baseline period and the cumulative quarters in impact phase (i.e. sixth quarter of the impact phase being assessed), the p-value for the differences in average dolphin encounter rates of STG and ANI were 0.0080 and 0.0032 respectively. Even if the alpha value is set at 0.01, significant difference was detected in both the average dolphin encounter rates of STG and ANI (i.e. between the two periods and the locations).

3.5.53 The AFCD monitoring data during March to May 2014 has been reviewed by the dolphin specialist, and only one group of three dolphins was sighted from 88.43 km of survey effort on primary lines in NEL during the same quarter. This review has confirmed that the very low occurrence of dolphins reported by the HKLR03 monitoring survey in spring 2014 in NEL is accurate.

3.5.54 There is no evidence showing that the sources of impact directly related to the construction works of HKLR03 that may have affected the dolphin usage in the NEL region.

3.5.55 All dolphin protective measures are fully and properly implemented in accordance with the EM&A Manual. The Contractor will continue to provide training to skippers to ensure that their working vessels travel from source to destination to minimize impacts on Chinese White Dolphin and avoid anchoring at Marine Department's designated anchorage site - Sham Shui Kok Anchorage (near Brothers Island) as far as practicable.

3.6 Mudflat Monitoring Results

Sedimentation Rate Monitoring

3.6.1 The baseline sedimentation rate monitoring was in September 2012 and impact sedimentation rate monitoring was undertaken on 17 March 2014. The mudflat surface levels at the four

established monitoring stations and the corresponding XYZ HK1980 GRID coordinates are presented in **Table 3.8** and **Table 3.9.**

Table 3.8 Measured Mudflat Surface Level Results

Monitoring Station	Baseline Monitoring (September 2012)			Impact Monitoring (March 2014)		
	Easting (m)	Northing (m)	Surface Level (mPD)	Easting (m)	Northing (m)	Surface Level (mPD)
S1	810291.160	816678.727	0.950	810291.**185**	**816678**.73**1**	**0.997**
S2	8**1**0958.272	815831.531	0.864	810958.291	815831.495	0.920
S3	810716.585	815953.308	1.341	810716.576	815953.305	1.405
S4	811221.433	816151.381	0.931	811221.438	816151.359	0.984

Table 3.9 Comparison of measurement

Monitoring Station	Comparison of measurement			Remarks and Recommendation
	Easting (m)	Northing (m)	Surface Level (mPD)	
S1	0.025	0.004	0.047	Within tolerance, no significant change
S2	0.019	-0.037	0.056	Within tolerance, no significant change
S3	-0.009	-0.003	0.064	Level increased
S4	0.005	-0.022	0.053	Within tolerance, no significant change

3.6.2 This measurement result was generally and relatively higher than the baseline measurement at S3. The mudflat level is continuously increased. For S1, S2 and S4 showed that the level has increased within tolerance and their sea bed depth would not be considered as significant change.

Water Quality Monitoring

3.6.3 The mudflat monitoring covered water quality monitoring data. Reference was made to the water quality monitoring data of the representative water quality monitoring station (i.e. SR3) as in the EM&A Manual. The water quality monitoring location (SR3) is shown in **Figure 2.1**.

3.6.4 Impact water quality monitoring in San Tau (monitoring station SR3) was conducted in March 2014. The monitoring parameters included dissolved oxygen (DO), turbidity and suspended solids (SS).

3.6.5 The Impact monitoring result for SR3 were extracted and summarised below:

Table 3.10 Impact Water Quality Monitoring Results (Depth Average)

Date	Mid Ebb Tide			Mid Flood Tide		
	DO (mg/L)	Turbidity (NTU)	SS (mg/L)	DO (mg/L)	Turbidity (NTU)	SS (mg/L)
03-Mar-14	7.76	13.8	7.4	7.81	8.30	4.15
05-Mar-14	7.48	7.85	9.5	7.38	7.15	8.30

Date	Mid Ebb Tide			Mid Flood Tide		
	DO (mg/L)	Turbidity (NTU)	SS (mg/L)	DO (mg/L)	Turbidity (NTU)	SS (mg/L)
07-Mar-14	7.03	1.55	7.4	7.19	3.85	8.90
10-Mar-14	7.45	8.10	13.9	7.20	4.15	4.20
12-Mar-14	7.53	7.75	9.3	7.25	6.95	7.35
14-Mar-14	7.32	15.6	12.95	7.57	10.35	12.10
17-Mar-14	7.34	18.75	29.2	7.34	8.05	11.9
19-Mar-14	7.11	22.05	36.7	7.15	10.10	11.25
21-Mar-14	6.64	18.55	15.65	7.17	11.70	17.7
24-Mar-14	6.91	1.55	8.85	7.26	3.80	9.45
26-Mar-14	7.50	5.65	7.80	7.56	5.90	6.20
28-Mar-14	7.94	8.60	11.35	8.90	6.85	11.65
31-Mar-14	7.35	9.45	16.9	7.13	8.50	15.60
Average	7.33	10.71	14.38	7.45	7.36	9.90

Mudflat Ecology Monitoring

Sampling Zone

3.6.6 There are two survey areas specified under the updated EM&A Manual for the Contract, namely Tung Chung Bay and San Tau. Tung Chung Bay survey area is divided into three sampling zones (TC1, TC2 and TC3) and there is one sampling zone at San Tau (ST). Survey of horseshoe crabs, seagrass beds and intertidal communities were conducted in each sampling zone. The present survey was conducted on 1, 2, 15, 16, 17 and 20 March 2014. The locations of sampling zones are shown in **Annex I of Appendix O**.

Horseshoe Crabs

3.6.7 An active search method was adopted for horseshoe crab survey at each sampling zone. The survey was undertaken by 2 specialists at each sampling zone. During the search period, any accessible and potential area would be investigated for any horseshoe crab individuals within 2-3 hours in low tide period (tidal level below 1.2 m above Chart Datum (C.D.)). Once a horseshoe crab was found, the species, size and inhabiting substrate, photographic record and respective GPS coordinate were recorded with reference to Li (2008). The horseshoe crab surveys were conducted on 17th (for zones TC1 and TC2) and 20th (for zones TC3 and ST) March 2014. The weather was cloudy and sunny on 17th and 20th March 2014 respectively.

Seagrass Beds

3.6.8 An active search method was adopted for seagrass bed survey at each sampling zone. The survey was undertaken by 2 specialists each spending within 2-3 hours in low tide period. Once seagrass bed was observed, the species, the estimated area (m^2), photographic record and respective GPS coordinate were recorded. The seagrass bed surveys were conducted on 17th (for zones TC1 and TC2) and 20th (for zones TC3 and ST) March 2014. The weather was cloudy and sunny on 17th and 20th March 2014 respectively.

Intertidal Soft Shore Communities

3.6.9 The sandy shore of San Tau and Tung Chung Bay from the uppermost part of the shore and to the water edge was divided into three tidal zones – upper, middle and lower zones, at each sampling zone, TC1, TC2, TC3 and ST. A 100m transect was laid in each of the three tidal zones for fauna sampling.

3.6.10 At each sampling zone, three 100m horizontal transects were laid at 2.0m, 1.5m and 1.0m above C.D. Along each transect, ten random quadrats (0.5 m x 0.5m) were placed. In each quadrat, the epifauna and infauna (within the top 5cm sediment) in each quadrat were identified and their numbers/coverage percentages were recorded. One core of 10cm diameter x 20cm depth was also collected within each quadrat. The sediments of the cores were sieved with 2mm mesh-size sieve and the biota inside was identified and counted. All collected fauna were released after recording except some tiny individuals that *in-situ* identification was not feasible. These tiny individuals were collected and were identified in the laboratory. Species and abundance of biota in both cores and quadrats were reported. The intertidal soft shore community surveys were conducted in low tide period on 1st (for ST), 2nd (for TC3), 15th (for TC1) and 16th March 2014 (for TC2).

Data Analysis

3.6.11 Data collected from direct search and core sampling was pooled in every quadrat for data analysis. Shannon-Weaver Diversity Index (H') and Pielou's Species Evenness (J) were calculated for every quadrat using the formulae below,

$H' = -\Sigma (Ni / N) \ln (Ni / N)$ (Shannon and Weaver, 1963)
$J = H' / \ln S$, (Pielou, 1966)

where S is the total number of species in the sample, N is the total number of individuals, and Ni is the number of individuals of the i^{th} species.

Mudflat Ecology Monitoring Results and Conclusion

Horseshoe Crabs

3.6.12 **Table 3.1 and Figure 3.1 of Appendix O** shows the records of horseshoe crab survey at every sampling zone. In general, *Tachypleus tridentatus* was found at sampling zone ST (45 ind.) while *Carcinoscorpius rotundicauda* was found at all sampling zones (TC1: 1 ind., TC2: 1 ind., TC3: 3 ind., ST: 16 ind.). All individuals were found on either fine sand or soft mud substratum. Grouping was observed while the group size ranged 2-8 individuals.

3.6.13 **Table 3.2 of Appendix O** summarizes the survey results of horseshoe crab at every sampling zone. For *Tachypleus tridentatus,* the search record was 7.50 ind. hr^{-1} $person^{-1}$ (mean prosomal width: 48.42 mm) at ST. According to Li (2008), the prosomal width of *Tachypleus tridentatus* recorded ranged 32.31－70.59 mm that corresponded to an estimated age of 4.0–8.3 years old. For *Carcinoscorpius rotundicauda*, the search records were 0.25 ind. hr^{-1} $person^{-1}$ (1 ind., prosomal width: 45.36 mm), 0.25 ind. hr^{-1} $person^{-1}$ (1 ind., prosomal width: 44.61 mm), 0.75 ind. hr^{-1} $person^{-1}$ (mean prosomal width: 49.81 mm), 2.67 ind. hr^{-1} $person^{-1}$ (mean prosomal width: 39.28 mm) at TC1, TC2, TC3 and ST respectively. The estimated age ranged 4.5-9.5 years old.

3.6.14 Besides, 18 and 3 labeled individuals of *Tachypleus tridentatus* were recorded in the survey of Sep. 2013 and Mar. 2014 respectively. All of them were released through a conservation programme conducted by Prof. Paul Shin (Department of Biology and Chemistry, The City University of Hong Kong (CityU)). It was a re-introduction trial of artificial bred and marked horseshoe crab juvenile at selected sites. So that the horseshoe crabs population might be restored in the natural habitat. Through a personal conversation with Prof. Shin, about 100 individuals were released to ST on 20 June 2013. All these labeled individuals were not included in the results of present monitoring programme.

3.6.15 **Figure 3.2 of Appendix O** shows the changes of number of individuals, mean prosomal width and search record of horseshoe crab *Tachypleus tridentatus* at every sampling zone along the sampling months. Among all the sampling months, high search record was found at ST. In contrast, much lower search record was found at other sampling zones especially at TC2 (2 ind. in Sep. 2013 and 1 ind. in Mar. 2014 only).

3.6.16 Based on the populations of both horseshoe crab species among the four sampling zones, it was obvious that ST was an important nursery ground for horseshoe crab especially newly hatched individuals due to larger area of suitable substratum (fine sand or soft mud) and less human disturbance (far from urban district). Relatively, other sampling zones were not suitable for nursery of horseshoe crab especially TC2. Possible factors were less area of suitable substratum (especially TC1) and higher human disturbance (TC1, TC2 and TC3: close to urban district and easily accessible by people). For TC2, large daily salinity fluctuation was a possible factor either since it was flushed by two rivers under tidal inundation. The individuals found in TC1, TC2 and TC3 were believed foraging from the ST during high tide while it might return to ST over a certain period. It accounted for the variable search records at the three sampling zones along the sampling months. Beside there was no spatial difference of horseshoe crab size (prosomal width) among the sampling zones.

3.6.17 During the survey period from Sep. 2012 to Mar. 2014, the search record of horseshoe crab declined obviously during dry season (Dec.) (**Figures 3.2 and 3.3 of Appendix O**). And no individual was found at all sampling zones in Dec. 2012. As mentioned, the horseshoe crabs were inactive and burrowed in the sediments during cold weather (<15 ℃). Similar results of low search record in dry seasons were reported in a previous territory-wide survey of horseshoe crab. For example, the search records at Tung Chung Wan were 0.17 ind. hr^{-1} $person^{-1}$ and 0 ind. hr^{-1} $person^{-1}$ in wet season and dry season respectively (details see Li, 2008). After December, the search record increased along with the warmer climate.

3.6.18 Relative to *Tachypleus tridentatus*, *Carcinoscorpius rotundicauda* was a less common species. During the survey period from Sep. 2012 to Dec 2013, it was not found except that 4 individuals were found at ST in Dec. 2012. This species was believed present in ST at very low number while encounter was rare. Until the present survey, it was recorded again at all sampling zones especially ST. Based on its average size (mean prosomal width 39.28-49.81 mm), it indicated that breeding of *Carcinoscorpius rotundicauda* had occurred 3-4 years ago. However, these individuals were still small while their walking trail was less conspicuous. It leaded to low visual detection in previous sampling months.

3.6.19 For *Tachypleus tridentatus,* sharp increase of number of individuals was recorded from Mar. 2013 (15 ind.), Jun. 2013 (59 ind.) to Sep. 2013 (94 ind.) at ST. According to a personal conversation with Prof. Shin (CityU), his monitoring team had recorded similar increase of horseshoe crab population during wet season this year. It was believed the suitable ambient temperature increased its conspicuousness.

3.6.20 **Figure 3.4 of Appendix O** shows the changes of prosomal width of horseshoe crab *Tachypleus tridentatus* and *Carcinoscorpius rotundicauda* at the important nursery ground ST. For *Tachypleus tridentatus,* it was believed that most of individuals (50% records between upper and lower quartile), recorded in the dry season, had grown to a size of double in Jun. 2013 (prosomal width increase from 10-20 mm to 30-50 mm). The individuals remained similar in size in Sep. 2013 followed by further size increase (32-71 mm) in Mar. 2014. It indicated the moulting period occurring during March-June and December-March. As mentioned, *Carcinoscorpius rotundicauda* was less common in ST while it was found in two sampling months only. Hence the change of size was yet to be determined.

3.6.21 The present survey was the sixth time of sampling of the EM&A programme during the construction period. Based on the results, impact of the HKLR project could not be detected on horseshoe crabs considering the factor of natural, seasonal variation. In case, abnormal phenomenon (e.g. very few numbers of horseshoe crab individuals in warm weather, large number of dead individuals on the shore) is observed, it would be reported as soon as possible.

Seagrass Beds

3.6.22 **Table 3.3 and Figure 3.5 of Appendix O** show the records of seagrass beds survey at every sampling zone. Seagrass was recorded in ST only summarized in Table 3.4. The most largest bed was composed of one long strand and two medium patches of *Halophila ovalis* nearby the

mangrove vegetation on sandy substratum at tidal level 2 m above C.D.. The estimated total area was about 713 m^2 with vegetation coverage 90-100%. In Dec. 2013, flowers were observed that indicated the reproductive period of *H. ovalis* **(Figure 3.6 of Appendix O)**.

3.6.23 Moreover, 24 small patches and 7 medium patches of *H. ovalis* were recorded on soft mud at tidal level between 1.0 m and 1.5 m above C.D.. The estimated area of each patch varied highly and ranged 1-72 m^2 with estimated coverage ranging 40-80%. The number of patches has been increasing since Sep. 2013. Seasonal recruitment and spreading of *H. ovalis* were occurring along with colder climate.

3.6.24 Four small patches of *Zostera japonica* were found within the long strand of *Halophila ovalis*. The estimated total area was 3.3 m^2 while the estimated coverage was about 10-60%.

3.6.25 **Figure 3.7 of Appendix O** shows the changes of estimated total area of seagrass beds at ST along the sampling months. For seagrass *Halophila ovalis*, the total area and estimated coverage increased gradually. It showed that the seagrass was in scattered patches on the shore during dry season of 2012. Then it grew larger or merged as larger patches during 2013. However it was doubt that the newly recruited patches of seagrass would survive the natural heat stress, predation and wave action in the next wet season.

3.6.26 For seagrass *Zostera japonica*, it was not reported in the surveys of Sep. and Dec. 2012. Seasonal recruitment of few patches was reported between December and March. Then the patch size increased and merged gradually with the warmer climate. However the patch size decreased sharply since Sep. 2013 and remained similar. The patch might not overcome the high heat stress exerted on shore between June and September 2013.

3.6.27 The present survey was the sixth time of sampling of the EM&A programme during the construction period. Based on the results, impacts of the HKLR project could not be detected on seagrass. The seagrass area of *Halophila ovalis* was increasing steadily due to natural growth and seasonal recruitment. Although that of *Zostera japonica* decreased in the Sep. 2013 survey, it would be the cause of natural heat stress. In case, abnormal phenomenon (e.g. rapid reduction of seagrass patch size) was observed, it would be reported as soon as possible.

Intertidal Soft Shore Communities

3.6.28 **Table 3.5 and Figure 3.8 of Appendix O** show the types of substratum along the horizontal transect at every tidal level of every sampling zone. The relative distribution of different substrata was estimated by investigating the substratum types (Gravels & Boulders / Sands / Soft mud) of the ten random quadrats along the horizontal transect.

3.6.29 The distribution of substratum types varied among tidal levels and sampling zones. At TC1, higher percentages of 'Gravels and Boulders' (70%) were recorded at high and mid tidal levels followed by 'Sands' (20-30%). Higher percentage of 'Gravels and Boulders' (60%) were recorded at low tidal level followed by 'Sands' (20%) and 'Soft mud' (20%). At TC2, high percentage of 'Sands' (60%) was recorded while the rest was 'Soft mud' (40%) at high tidal level. 'Sands' was recorded only at mid tidal level. Higher percentage of 'Soft mud' (70%) was recorded at low tidal level followed by 'Sands'. At TC3, 'Sands' (100%) was recorded only at high tidal level. High percentage of 'Sands' (70%) was recorded at mid tidal level followed by 'Soft mud' (30%). 'Gravels and Boulders' was recorded only (100%) at low tidal level. At ST, 'Gravels and Boulders' (90-100%) was the major substratum at high and mid tidal levels. Even distribution of 'Soft mud' (50%), 'Sands' (30%) and 'Gravels and Boulders' (20%) were recorded at low tidal level.

3.6.30 There was neither consistent vertical nor horizontal zonation pattern of substratum type in the study site. Such heterogeneous variation should be caused by different hydrology (e.g. wave in different direction and intensity) received by the four sampling zones.

3.6.31 **Table 3.6 of Appendix O** lists the total abundance, density and number of taxon of every phylum in the present survey. A total of 14383 individuals were recorded. Mollusks were

significantly the most abundant phylum (total individuals 14165, density 472 ind. m^{-2}, relative abundance 98.5%). The second abundant group was arthropod (total individuals: 113, density 4 ind. m^{-2}, 0.8%). Relatively other phyla were very low in abundance (≤0.4%). Similarly, the most diverse phylum were mollusks (40 taxa) followed by arthropods (11 taxa) and annelids (10 taxa). The taxa of other phyla were relatively less (1 taxon). The complete list of collected specimens is provided in **Annex III of Appendix O**.

3.6.32 **Table 3.7 of Appendix O** shows the number of individual, relative abundance and density of each phylum at every sampling zone. The results were similar among the four sampling zones. In general, mollusks were the most dominant phylum (no. of individuals: 1732-4800 ind., relative abundance 95.4-99.0%). Arthropods were the second abundant phylum (no. of individuals: 16-44 ind., 0.4-2.4%) although the number of individuals was significantly lower than that of mollusks. Relatively, other phyla were very low in abundance across the four sampling zones (< 1%) except the annelids at TC2 (no. of individuals: 26 ind., relative abundance 1.4%).

3.6.33 **Table 3.8 of Appendix O** lists the abundant species (relative abundance >10%) at every sampling zone. At TC1, gastropod *Batillaria multiformis* was abundant at all tidal levels especially high tidal level (133-526 ind. m^{-2}, relative abundance 26-80%). Rock oyster *Saccostrea cucullata* was at moderate abundance at mid and low tidal levels (84-133 ind. m^{-2}, 16-32%). Gastropod *Monodonta labio* (43-74 ind. m^{-2}, 10-14%) was the third abundant at mid and low tidal levels.

3.6.34 At TC2, gastropods *Batillaria multiformis* (84 ind. m^{-2}, relative abundance 34%) and *Cerithidea djadjariensis* (76 ind. m^{-2}, 31%) were abundant at high tidal level. At mid tidal level, rock oyster *Saccostrea cucullata* was the most abundant (86 ind. m^{-2}, 32%) followed by less abundant gastropods *Cerithidea djadjariensis* (45 ind. m^{-2}, 17%) and *Batillaria zonalis* (39 ind. m^{-2}, 14%). At low tidal level, gastropod *Batillaria zonalis* (77 ind. m^{-2}, 37%) was the most abundant species followed by rock oyster *Saccostrea cucullata* (33 ind. m^{-2}, 16%), *Cerithidea djadjariensis* (33 ind. m^{-2}, 16%) and *Batillaria multiformis* (24 ind. m^{-2}, 12%).

3.6.35 At TC3, gastropod *Batillaria multiformis* was highly abundant at all tidal levels (214-444 ind. m^{-2}, relative abundance 43-65%). Gastropod *Cerithidea djadjariensis* (146 ind. m^{-2}, 21%) and *Monodonta labio* (97 ind. m^{-2}, 26%) were the second abundant at high and mid tidal levels respectively. At low tidal level, other abundant species were rock oyster *Saccostrea cucullata* (186 ind. m^{-2}, 21%) and gastropod *Cerithidea djadjariensis* (162 ind. m^{-2}, 18%).

3.6.36 At ST, gastropod *Batillaria multiformis* was highly abundant (585 ind. m^{-2}, relative abundance 73%) at high tidal level followed by gastropod *Monodonta labio* (81 ind. m^{-2}, 10%). At mid tidal level, rock oyster *Saccostrea cucullata* was the most abundant (162 ind. m^{-2}, 31%) while other less abundant taxa were gastropods *Batillaria multiformis* (131 ind. m^{-2}, 25%) and *Monodonta labio* (62 ind. m^{-2}, 12%). At low tidal level, rock oyster *Saccostrea cucullata* (49 ind. m^{-2}, 32%), gastropods *Cerithidea djadjariensis* (24 ind. m^{-2}, 16%) and *Batillaria zonalis* (23 ind. m^{-2}, 15%) were abundant taxa with much lower abundance relative to that at high and mid tidal levels.

3.6.37 There was no consistent zonation pattern of species distribution observed across sampling zones and tidal levels in Tung Chung Wan and San Tau. The species distribution should be determined by the type of substratum primarily. In general, gastropods *Batillaria multiformis* (7002 ind., 49%) and *Cerithidea djadjariensis* (1749 ind., 12%) were the most common occurring species on sandy substratum mainly among the four sampling zones. Moreover rock oyster *Saccostrea cucullata* (2089 ind., 15%) and gastropod *Monodonta labio* (1032 ind., 7%) were commonly occurring species inhabiting gravel and boulders substratum.

3.6.38 **Table 3.9 of Appendix O** shows the mean values of number of species, density, *H'* and *J* of soft shore communities at every tidal level and sampling zone. Among the sampling zones, the mean number of species was generally similar (6-14 spp. 0.25 m^{-2}). The mean densities of TC3 (376-879 ind. m^{-2}) was generally higher than that of TC1 (417-656 ind. m^{-2}) followed by ST (152-800 ind. m^{-2}) and TC2 (211-270 ind. m^{-2}). The mean biodiversity index was similar and

ranged 1.13-1.53. The species evenness at TC2 (0.75) was generally higher than that at other sampling zones (0.53-0.61).

3.6.39 Across the tidal levels, there was no difference of the mean number of species. Higher mean densities were observed at high and mid tidal levels except the sampling zone TC3. Usually higher mean biodiversity index and species evenness were observed at mid and low tidal levels.

3.6.40 **Figure 3.9 of Appendix O** shows the temporal changes of number of species, density, *H'* and *J* at every tidal level and sampling zone since the baseline monitoring survey (Sep 2012). No significant temporal change of any biological parameters was observed at all sampling zones. Although declined densities were observed during dry season (December), it was believed a natural, seasonal variation due to higher mortality and lower activity rate of intertidal fauna during cold, dry season. The densities of both sampling zones had increased along with the hot, wet season.

3.6.41 The present survey was the sixth time of sampling of the EM&A programme during the construction period. Based on the results, impacts of the HKLR project were not detected on intertidal soft shore community.

3.7 Solid and Liquid Waste Management Status

3.7.1 The Contractor registered with EPD as a Chemical Waste Producer on 12 July 2012 for the Contract. Sufficient numbers of receptacles were available for general refuse collection and sorting.

3.7.2 The summary of waste flow table is detailed in **Appendix K**.

3.7.3 The Contractor was reminded that chemical waste containers should be properly treated and stored temporarily in designated chemical waste storage area on site in accordance with the Code of Practise on the Packaging, Labelling and Storage of Chemical Wastes.

3.8 Environmental Licenses and Permits

3.8.1 The valid environmental licenses and permits during the reporting period are summarized in **Appendix L.**

4 Environmental Complaint and Non-compliance

4.1 Environmental Exceedances

4.1.1 The detailed air quality, noise, water quality and dolphin exceedances are provided in **Appendix M**. Also, the summaries of the environmental exceedances are presented as followed:

Air Quality

4.1.2 For air quality, there were no Action and Limit Level exceedances for 1-hr TSP recorded during this reporting period. For 24-hour TSP, one Action level exceedance was recorded at station AMS6 on 20 March 2014.

Noise

4.1.3 No Action and Limit Level exceedances for noise were recorded during this reporting period.

Water Quality

4.1.4 During the reporting period, there were thirteen Action Level exceedances and two Limit Level exceedances of suspended solids level. No exceedances of turbidity level and dissolved oxygen level were recorded. There were no specific activities recorded during the monitoring period that would cause any significant impacts on monitoring results and no leakage of turbid water or any abnormity or malpractice was observed during the sampling exercise. Therefore, all exceedances were considered as non-contract related. The detailed numbers of exceedances recorded during the reporting period at each impact station are summarised in **Table 4.1.**

Dolphin

4.1.5 There were two Action Level exceedances of dolphin monitoring for the quarterly monitoring data (March – May 2014). According to the contractor's information, the marine activities undertaken for HKLR03 during the two quarterly periods (December 2013 to February 2014 and March 2014 to May 2014) included stone platform construction, reclamation, stone column installation and excavation of stone platform, surcharge activities, construction of seawall and geotextile tube installation works.

4.1.6 There is no evidence showing the current AL non-compliance directly related to the construction works of HKLR03, although the generally increased amount of vessel traffic in NEL during the impact phase has been partly contributed by HKLR03 works since October 2012. It should also be noted that reclamation work under HKLR03 (adjoining the Airport Island) situates in waters which has rarely been used by dolphins in the past, and the working vessels under HKLR03 have been travelling from source to destination in accordance with the Marine Travel Route to minimize impacts on Chinese White Dolphin. In addition, the contractor will implement proactive mitigation measures such as avoiding anchoring at Marine Department's designated anchorage site – Sham Shui Kok Anchorage (near Brothers Island) as far as practicable.

4.1.7 All dolphin protective measures are fully and properly implemented in accordance with the EM&A Manual. The Contractor will continue to provide training to skippers to ensure that their working vessels travel from source to destination to minimize impacts on Chinese White Dolphin and avoid anchoring at Marine Department's designated anchorage site - Sham Shui Kok Anchorage (near Brothers Island) as far as practicable.

Table 4.1 Summary of Water Quality Exceedances

Station	Exceedance Level	DO (S&M)		DO (Bottom)		Turbidity		SS		Total Number of Exceedances	
		Ebb	Flood	Ebb	Flood	Ebb	Flood	Ebb	Flood	Ebb	Flood
IS5	Action Level	--	--	--	--	--	--	17 Mar 2014 19 Mar 2014 2 Apr 2014	--	3	0
	Limit Level	--	--	--	--	--	--	--	--	0	0
IS(Mf)6	Action Level	--	--	--	--	--	--	19 Mar 2014	--	1	0
	Limit Level	--	--	--	--	--	--	--	--	0	0
IS7	Action Level	--	--	--	--	--	--	--	31 Mar 2014	0	1
	Limit Level	--	--	--	--	--	--	--	--	0	0
IS8	Action Level	--	--	--	--		--	--	--	0	0
	Limit Level	--	--	--	--	--	--	--	--	0	0
IS(Mf)9	Action Level	--	--	--	--	--	--	--	26 Mar 2014 31 Mar 2014	0	2
	Limit Level	--	--	--	--	--	--	--	--	0	0
IS10	Action Level	--	--	--	--	--	--	31 Mar 2014	17 Mar 2014 19 Mar 2014	1	2
	Limit Level	--	--	--	--	--	--	--	--	0	0
SR3	Action Level	--	--	--	--	--	--	17 Mar 2014	--	1	0
	Limit Level	--	--	--	--	--	--	19 Mar 2014	--	1	0
SR4	Action Level	--	--	--	--		--	--	--	0	0
	Limit Level	--	--	--	--	--	--	--	14 May 2014	0	1
SR5	Action Level	--	--	--	--	--	--	21 Mar 2014	19 Mar 2014	1	1
	Limit Level	--	--	--	--	--	--	--	--	0	0
SR10A	Action Level	--	--	--	--	--	--	--	--	0	0
	Limit Level	--	--	--	--	--	--	--	--	0	0
SR10B	Action Level	--	--	--	--	--	--	--	--	0	0
	Limit Level	--	--	--	--	--	--	--	--	0	0
Total	**Action**	0	0	0	0	0	0	7	6	13**	
	Limit	0	0	0	0	0	0	1	1	2**	

Notes:
S: Surface;
M: Mid-depth;
* The total exceedances.

4.2 Summary of Environmental Complaint, Notification of Summons and Successful Prosecution

4.2.1 There were three environmental complaints received during this reporting period. All investigation reports for exceedances of the Contract have been submitted to ENPO/IEC for comments and/or follow up to identify whether the exceedances occurred related to other HZMB contracts. The summary of environmental complaints is presented in **Table 4.2**. The details of environmental complaints are presented in **Appendix N**.

Table 4.2 Summary of Environmental Complaints for the Reporting Period

Environmental Complaint No.	Date of Complaint Received	Description of Environmental Complaints
COM-2014-050	24 March 2014	Other: Dredged marine sediment
COM-2014-051	29 April 2014	Noise
COM-2014-052	2 May 2014	Noise

4.2.2 No notification of summons and prosecution was received during the reporting period.

4.2.3 Statistics on notifications of summons and successful prosecutions are summarized in **Appendi x M**.

5 COMMENTS, RECOMMENDATIONS AND CONCLUSION

5.1 Comments

5.1.1 According to the environmental site inspections undertaken during the reporting period, the following recommendations were provided:

- The Contractor was reminded to clean up the excess fill materials on the passage way of vessel Lun Li at S7 and vessel Shing Ming 83.
- The Contractor was reminded to provide maintenance/place properly for the silt curtains at Portion X.
- The Contractor was reminded to provide the noise emission label for hand held breaker at N4 and air compressor at N1 and S16.
- The Contractor was reminded to clean up the stagnant water inside the drip tray at S8/S9 and S15.
- The Contractor was reminded to clean up the muddy water on the public road at S8/S9, S15, S16 and S25.
- The Contractor was reminded to provide clear labels for waste oil and chemical containers at S8/S9.
- The Contractor was reminded to clean up the oil film inside the washing wheel bay at S8/S9.
- The Contractor was reminded to provide cover or water spraying for the dry stockpiles at S19.
- The Contractor was reminded to provide the drip tray for the oil container at S15/S11, N4 and at vessel of Hoi Pok 9.
- The Contractor was reminded to provide the drip tray for the waste chemical containers at N13.
- The Contractor was reminded to clean up the oily film at S8 and S16.
- The Contractor was reminded to clear up the leakage oil and remove the diesel tank at S16.
- 8. The Contractor was reminded to provide the water spray on the haul road at S19.
- The Contractor was reminded to provide maintenance for the noise barrier at S16/S11.
- The Contractor was reminded to clean up the oil spillage at S8.
- The Contractor was reminded to provide a drip tray for the oil drum at S16/S11.
- The Contractor was reminded to clean up the oily water and store properly for disposal at N1.
- The Contractor was reminded to clean up the fill materials on passage way of vessel Shing Ming 98.
- The Contractor was reminded to provide drip trays for the chemical containers at FB101, N1, S8 and N4.
- The Contractor was reminded to provide a stopper for the drain hole of the drip tray at S22 and S25.
- The Contractor was reminded to remove construction materials from the drip trays at S22.
- The Contractor was reminded to remove construction materials and rubbish bin from the drip trays at S25.
- The Contractor was reminded to clean up the stagnant water and fill up the recesses for the lifting eyes of concrete blocks at S25.
- The Contractor was reminded to clean up the fill materials on passage way of vessel Kiu Tak.

- The Contractor was reminded to provide a drip tray for the waste oil container at N13.
- The Contractor was reminded to provide a cover for the opened cement bags at S11.
- The Contractor was reminded to remove the stagnant water inside the recesses for lifting eyes of concrete blocks at N1.
- The Contractor was reminded to close the gap for silt curtains at Portion X.
- The Contractor was reminded to clean up the fill materials on passage way of vessel Shing Ming 83.
- The Contractor was reminded to provide a drip tray for waste oil and chemical containers at S11/S16.
- The Contractor was reminded to clean up the oily film at S11/S16 and S15.
- The Contractor was reminded to clean up the stagnant water inside the tubes at N4A.
- The
- The Contractor was reminded to provide a 3-side sheltered cover for the cement mixing plant at S8.
- The Contractor was reminded to provide a drip tray for the oil container at S15/S11.
- The Contractor was reminded to provide water spraying on the dry sand stockpile at S16.
- The Contractor was reminded to place the chemical inside a drip tray properly at S16.
- The Contractor was reminded to clean up the stagnant water inside the recesses for lifting eyes of concrete blocks at N13.
- The Contractor was reminded to provide a proper impervious cover for the cement bags at S16/S11 and S23.
- The Contractor was reminded to remove the stagnant water inside the bucket at S15.
- The Contractor was reminded to provide a drip tray and clear label for the waste oil container at Shing Ming 83.
- The Contractor was reminded to close the gaps between the silt curtains at Portion X.
- The Contractor was reminded to clean up the stagnant water at N4.
- The Contractor was reminded to provide a properly cover for the sand stockpiles at N24.
- The Contractor was reminded to clean up the stagnant water which inside the drip tray at S8-S9.
- The Contractor was reminded to provide a 3-sided shelter for the cement storage area at S8-S9.
- The Contractor was reminded to remove the oily film inside the wastewater collection pit at N1.
- The Contractor was reminded to close the gap between the enclosed area and barge parking place at S7.
- The Contractor was reminded to cover the cement bags entirely by impervious sheeting or placed them in an area sheltered on the top and 3 sides cement bags at S19.
- The Contractor was reminded to clean up the stagnant water inside recesses for lifting eyes of the water crash barrier at WA06.
- The Contractor was reminded to remove stagnant water at N13 and WP4.
- The Contractor was reminded to cover bags of cement entirely with impervious sheets to avoid dust emission at WP5.

5.2 Recommendations

5.2.1 The impact monitoring programme for air quality, noise, water quality and dolphin ensured that any deterioration in environmental condition was readily detected and timely actions taken to rectify any non-compliance. Assessment and analysis of monitoring results collected demonstrated the environmental impacts of the contract. With implementation of the recommended environmental mitigation measures, the contract's environmental impacts were considered environmentally acceptable. The weekly environmental site inspections ensured that all the environmental mitigation measures recommended were effectively implemented.

5.2.2 The recommended environmental mitigation measures, as included in the EM&A programme, effectively minimize the potential environmental impacts from the contract. Also, the EM&A programme effectively monitored the environmental impacts from the construction activities and ensure the proper implementation of mitigation measures. No particular recommendation was advised for the improvement of the programme.

5.3 Conclusions

5.3.1 The construction phase and EM&A programme of the Contract commenced on 17 October 2012. This is the Seventh Quarterly EM&A Report which summarises the monitoring results and audit findings of the EM&A programme during the reporting period from 1 March to 31 May 2014.

Air Quality

5.3.2 For air quality, there were no Action and Limit Level exceedances for 1-hr TSP recorded during this reporting period.

5.3.3 For 24-hour TSP, one Action level exceedance was recorded at station AMS6 on 20 March 2014.

Noise

5.3.4 For construction noise, there were no Action Level and Limit Level exceedances during the reporting period.

Water Quality

5.3.5 During the reporting period, there were thirteen Action Level exceedances and two Limit Level exceedances of suspended solids level.

Dolphin

5.3.6 There was two Action Level exceedances of dolphin monitoring for the quarterly monitoring data (March – May 2014).

5.3.7 During this quarter of dolphin monitoring, no adverse impact from the activities of this construction project on Chinese White Dolphins was noticeable from general observations.

5.3.8 Although dolphins rarely occurred in the area of HKLR03 construction in the past and during the baseline monitoring period, it is apparent that dolphin usage has been significantly reduced in NEL in 2012 and 2013, and many individuals have shifted away from the important habitat around the Brothers Islands.

5.3.9 It critical to monitor the dolphin usage in North Lantau region in the upcoming quarters, to determine whether the dolphins are continuously affected by the various construction activities in relation to the HZMB-related works, and whether suitable mitigation measure can be applied to revert situation.

Mudflat -Sedimentation Rate

5.3.10 This measurement result was generally and relatively higher than the baseline measurement at S3. The mudflat level is continuously increased. For S1, S2 and S4 showed that the level has increased within tolerance and their sea bed depth would not be considered as significant change.

5.3.11 Impact water quality monitoring in San Tau (monitoring station SR3) was conducted in March 2014. The monitoring parameters included dissolved oxygen, turbidity and suspended solids.

Mudflat - Ecology

5.3.12 An active search method was adopted for horseshoe crab survey at each sampling zone. In general, horseshoe crab *Tachypleus tridentatus* was found at sampling zone ST (45 ind.) while *Carcinoscorpius rotundicauda* was found at all sampling zones(TC1: 1 ind., TC2: 1 ind., TC3: 3 ind., ST: 16 ind.). All individuals were found on either fine sand or soft mud substratum. Grouping was observed while the group size ranged 2-8 individuals. Among all the sampling months, high search record was found at ST. In contrast, much lower search record was found at other sampling zones especially at TC2 (2 ind. in Sep. 2013 and 1 ind. in Mar. 2014 only). Based on the populations of both horseshoe crab species among the four sampling zones, it was obvious that ST was an important nursery ground for horseshoe crab especially newly hatched individuals due to larger area of suitable substratum (fine sand or soft mud)

and less human disturbance (far from urban district). Relatively, other sampling zones were not suitable for nursery of horseshoe crab especially TC2. Possible factors were less area of suitable substratum (especially TC1) and higher human disturbance (TC1, TC2 and TC3: close to urban district and easily accessible by people).

5.3.13 In March 2014 survey, *Carcinoscorpius rotundicauda* was recorded again at all sampling zones especially ST. Based on its average size (mean prosomal width 39.28-49.81 mm), it indicated that breeding of *Carcinoscorpius rotundicauda* had occurred 3-4 years ago. However, these individuals were still small while their walking trail was less conspicuous. It leaded to low visual detection in previous sampling months. As mentioned, *Carcinoscorpius rotundicauda* was less common in ST while it was found in two sampling months only. Hence the change of size was yet to be determined.

5.3.14 An active search method was adopted for seagrass bed survey at each sampling zone. Seagrass was recorded in ST only. The most largest bed was composed of one long strand and two medium patches of *Halophila ovalis* nearby the mangrove vegetation on sandy substratum at tidal level 2 m above C.D.. The estimated total area was about 713 m^2 with vegetation coverage 90-100%. Moreover, 24 small patches and 7 medium patches of *H. ovalis* were recorded on soft mud at tidal level between 1.0 m and 1.5 m above C.D.. The estimated area of each patch varied highly and ranged 1-72 m^2 with estimated coverage ranging 40-80%. The number of patches has been increasing since Sep. 2013. Seasonal recruitment and spreading of *H. ovalis* were occurring along with colder climate. Four small patches of *Zostera japonica* were found within the long strand of *Halophila ovalis*. The estimated total area was 3.3 m^2 while the estimated coverage was about 10-60%.

5.3.15 The intertidal soft shore community surveys were conducted in low tide period at each sampling zone). A total of 14383 individuals were recorded. Mollusks were significantly the most abundant phylum (total individuals 14165, density 472 ind. m^{-2}, relative abundance 98.5%). The second abundant group was arthropod (total individuals: 113, density 4 ind. m^{-2}, 0.8%). Relatively other phyla were very low in abundance (≤0.4%). Similarly, the most diverse phylum were mollusks (40 taxa) followed by arthropods (11 taxa) and annelids (10 taxa). The taxa of other phyla were relatively less (1 taxon).

5.3.16 There was no consistent zonation pattern of species distribution observed across sampling zones and tidal levels in Tung Chung Wan and San Tau. The species distribution should be determined by the type of substratum primarily. In general, gastropods *Batillaria multiformis* (7002 ind., 49%) and *Cerithidea djadjariensis* (1749 ind., 12%) were the most common occurring species on sandy substratum mainly among the four sampling zones. Moreover rock oyster *Saccostrea cucullata* (2089 ind., 15%) and gastropod *Monodonta labio* (1032 ind., 7%) were commonly occurring species inhabiting gravel and boulders substratum.

5.3.17 The March 2014 survey was the sixth time of sampling of the EM&A programme during the construction period. Based on the results, impacts of the HKLR project were not detected on horseshoe crabs, seagrass and intertidal soft shore community.

Environmental Site inspection and Audit

5.3.18 Environmental site inspection was carried out on 5, 12, 19 and 28 March 2014, 2, 9, 16, 25 and 30 April 2014 and 7, 14, 21 and 30 May 2014. Recommendations on remedial actions were given to the Contractors for the deficiencies identified during the site inspections.

5.3.19 There were three environmental complaints received during this reporting period.

5.3.20 No notification of summons and prosecution was received during the reporting period.

FIGURES

APPENDIX A

Environmental Management Structure

APPENDIX B

Construction Programme

APPENDIX C

Location of Works Areas

APPENDIX D

Event and Action Plan

APPENDIX E

Implementation Schedule of Environmental Mitigation Measures

APPENDIX F

Site Audit Findings and Corrective Actions

APPENDIX G

Air Quality Monitoring Data and Graphical Plots

APPENDIX H

Noise Monitoring Data and Graphical Plots

APPENDIX I

Water Quality Monitoring Data and Graphical Plots

APPENDIX J

Dolphin Monitoring Results

APPENDIX K

Waste Flow Table

APPENDIX L

Summary of Environmental Licenses and Permits

APPENDIX M

Record of "Notification of Environmental Quality Limit Exceedances

APPENDIX N

Cumulative Statistic on Complaints

APPENDIX O

Mudflat Monitoring Results